

Iron and Vitamin C and D Deficiencies in a Large Population of Children

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IRON deficiency anemia is the most widespread nutritional deficiency syndrome recognized in the United States today (1, 2). Symptomatic vitamin C and vitamin D deficiency states are believed rare.

In Tennessee, of 74,027 apparently well children under age 6 from low and middle income families brought to 88 rural health centers, 18 percent were discovered to be anemic.

Conversely, of 21,046 radiological records of ill children, ages 6 months through 5 years, screened at the Vanderbilt Univ-

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ersity Hospital over a 4-year period, only one child had vitamin D deficiency rickets, and none had scurvy attributed to vitamin C deficiency.

This paper describes the extent of these deficiencies in children in Tennessee, the process of attacking the deficiencies, and the outcomes, benefits, and costs resulting from the process.

Iron Deficiency Anemia

Iron deficiency anemia has many causes. Three of these causes, which account for most cases of iron deficiency, were documented at a recent conference on pediatric research (1).

1. Enriched cereal is depended upon to supply infants with iron even though the biological availability of iron in cereal is uncertain.

2. Most mothers discontinue enriched cereal when infants need iron most.

3. Whole cow's milk can cause enteric blood loss in infants when the amount of milk consumed is large.

Recently a committee on nutri-

tion of the American Academy of Pediatrics (3), noting the difficulty in providing infants with enough iron through diet, recommended that iron supplemented formulas be used routinely as the standard; that is, that it be the rule rather than the exception. Formula-fed infants should, the committee recommended, continue the same iron-fortified formula until the infant is at least 12 months old.

All the Tennessee children were first seen before any education, prevention, or treatment was initiated. We defined anemic children as those with microhematocrit values of 31 percent or less packed red cells per total sample of blood. Children with a microhematocrit value of 32-35 percent, however, may also need added iron (4).

Public health nurses deliver well baby services in health centers located in the principal town of nearly every county in Tennessee. One-half the entire child population of Tennessee lives in the rural 88-county area surveyed in this paper. Included in the cen-



Nurse prepares to test child for anemia by microhematocrit

ter's services are performing microhematocrits and the prevention and treatment of anemia.

In our treatment and prevention program, we prescribe a daily preventive dose of supplemental elemental iron of 10 mg. per day if the percentage packed red cell volume is between 32–35 percent; a treatment dose of 25 mg. daily if the percentage packed red cell volume is 30–31

percent; 40 mg. if the percentage is 28–29 percent; and 70 mg. if the percentage is 27 percent or less. Each child is also given vitamins A, C, and D in addition to iron.

We believe that the screening of 74,027 children for anemia at the centers was one of the largest such projects ever conducted. A 4-year summary (1967–70) of the well children tested at health

centers by age, color, and percentage anemic follows:

<i>Age and race</i>	<i>Number</i>	<i>Percent anemic</i>
0–2 years:		
White.....	41,770	21.1
Black.....	7,931	29.0
3–5 years:		
White.....	20,151	7.1
Black.....	4,175	13.4
Total.....	74,027	17.7

The number and percentage of 1-year-old children in health cen-



Checking child's heart is important part of well baby services

ters with microhematocrit values of 31 percent or less by color and year tested are shown in the table.

The reduction in children found anemic may have been due to nurses selecting healthier 1-year-olds in 1970 than in previous years, because 1970 is the year showing the most significant drop. Interviews with the nurses did not reveal any selection. Fur-

ther study of this question is planned.

These tabulations show (a) anemia is common in Tennessee children, (b) an alarmingly high incidence of anemia in 1-year-olds, (c) a higher percentage of anemic black than anemic white 1-year-olds (d) that although anemia is more common in young children, older ones are frequently anemic, (e) a gradual re-

duction over time in the percentage of white children discovered anemic, and (f) a more rapid reduction over time of black children discovered anemic.

Evaluation

With considerable effort being expended to find, prevent, and treat iron-deficiency anemia, we needed to evaluate our efforts. Therefore, a sample of 576 chil-

dren with microhematocrit values of 29 percent or less were tested 6 to 12 months after treatment. Ninety-three percent improved significantly, 3 percent were unchanged, and only 4 percent were lost to followup (5).

Benefits to Mother

Three indirect benefits of the detection and treatment program were important to the health department and the families served.

1. Mothers appreciated the service.
2. Irritability decreased in babies as the hematocrit rose.
3. Immunizations were more likely to be completed when microhematocrits were done and vitamins with iron dispensed.

Rickets and Scurvy

Cases of symptomatic scurvy and rickets are being discovered in small numbers by physicians actively looking for bone lesions, even though biochemical "unacceptable" levels of vitamin C and D are common among children in the United States (6).

The population screened for

Number and percent of 1-year-old children tested in health centers by color and year tested

Year	Black		White	
	Total tested	Percent anemic	Total tested	Percent anemic
1967.....	454	39.9	2,010	27.4
1968.....	313	36.4	2,045	25.7
1969.....	355	38.0	1,919	25.3
1970.....	423	31.0	2,790	23.3

rickets and scurvy were from both urban and rural areas. These children with major illnesses had been referred to the Vanderbilt University Hospital by physicians in private practice and public health nurses. Only one child had vitamin D deficiency rickets, and none had scurvy.

Costs

Our health centers are supplied with convenient bottles with droppers which contain 50 cc. of ferrous sulfate at less than 1 cent for 25 mg. of elemental iron. Vitamins with iron cost less than 1 cent for a dose containing 10 mg. of elemental iron. The total cost of equipment, supplies, vitamins, and iron for the 4-year period was \$69,000 or 94 cents per child.

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Iron deficiency anemia is a major public health problem in Tennessee. Of 74,027 children under age 6 brought to 88 rural health centers, 18 percent were anemic. Children were considered anemic if their microhematocrit value was 31 per-

cent or less. More 1-year-olds were discovered anemic than any other age group and, for all age groups, black children were more likely to be anemic than were white children.